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AGRICULTURAL, FOOD, POULTRY
AND EGGS RESEARCH
DEPARTMENT OF AGRICULTURE

LETTER

FROM

THE ACTING SECRETARY OF AGRICULTURE

TRANSMITTING

IN RESPONSE TO SENATE RESOLUTION NO. 348 (SEVENTIETH CONGRESS)
A STATEMENT SHOWING THE ESTIMATED ALLOCATION OF FED-
ERAL FUNDS FOR AGRICULTURAL, FOOD, POULTRY AND EGGS
RESEARCH BY THE DEPARTMENT OF AGRICULTURE,
APPLICABLE TO THE FISCAL YEARS 1929 AND 1930



SEPTEMBER 4, 1929.—Referred to the Committee on Agriculture and Forestry
and ordered to be printed

UNITED STATES
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WASHINGTON : 1929



LETTER OF TRANSMITTAL

DEPARTMENT OF AGRICULTURE,
Washington, D. C., August 2, 1929.

The PRESIDENT OF THE SENATE.

SIR: Pursuant to Senate Resolution 348 of the Seventieth Congress, a copy of which was transmitted to this department by the Secretary of the Senate, there is inclosed a tabular statement showing the estimated allocation of Federal funds for agricultural research, food research, and research on poultry and eggs, administered by the Department of Agriculture, applicable to the fiscal years 1929 and 1930. There is also inclosed a separate statement of the benefits to the consumer resulting from the food-research work of the department.

In compliance with title 44, section 140, page 1423, of the Code of Laws of the United States, requiring "an estimate of the probable cost of printing the usual number," it is thought that \$125 will cover publication charges, this estimate being based on an edition of 1,325 copies.

Respectfully,

R. W. DUNLAP,
Acting Secretary.

AGRICULTURAL, FOOD, POULTRY, AND EGGS RESEARCH, DEPARTMENT OF AGRICULTURE

STATEMENT OF BENEFITS TO CONSUMER RESULTING FROM FOOD- RESEARCH WORK OF THE DEPARTMENT OF AGRICULTURE

BUREAU OF ANIMAL INDUSTRY

The relation of the food-research work of the Bureau of Animal Industry to consumer benefit is intimate and direct and falls appropriately under two heads: First, the increase in production of food animals, with improvement in quality of meats and other products derived from them; and, second, the protection of human health. Investigations of animal diseases, including parasitic infestations, and work on animal feeding and breeding, come under the first head, while studies of animal diseases and conditions and parasitic infestations which may be transmissible to consumers are examples of the second.

Examples of the work accomplished are indicated by the following projects completed or now under way:

Bacillary white diarrhea.—It is estimated that each year at least 100,000,000 young chicks die of this disease, with an estimated loss of \$10,000,000. Researches are directed toward means for eliminating the disease from flocks so that only normal eggs will be incubated and to the development of methods for checking the spread of infection if it finds its way into the incubator.

Nutritive properties of meats and meat products.—Investigation has shown that the proteins in beef, pork, and lamb enhance the nutritive value of cereal proteins so that a mixture of the two is an adequate and economical food. Studies of beef, pork, lamb, poultry flesh, eggs, edible organs, and parts from cattle, sheep, and hogs, and certain manufactured products as oleo oil, oleo stearin, beef extract, etc., have demonstrated that pork is unusually rich in the anti-neuritic vitamin, (vitamin F), which is an absolute essential for growth and health, and it is of much importance to know that this vitamin is supplied abundantly by pork, as well as by liver and kidneys, all of which are comparatively cheap food products.

Trichinæ.—An inexpensive control measure was furnished about 10 years ago, making unnecessary a microscopic examination, which would cost \$5,000,000 a year.

Beef measles parasite.—This organism is transmissible to man. A control method has been devised which effectively protects the consuming public and at small cost to the packer. It also enables the packer to salvage larger portions of the many thousands of infested carcasses that come to the abattoirs.

Other parasites.—Among the parasites occurring in meat are flukes, cysticerci, and kidney worms in the liver, ox warbles and gullet worms in the weasands which are used as casings, cysticerci in mutton, worm nodules in intestinal casings, and kidney worms in the kidneys and leaf lard. Research has resulted in the control of some of these parasites and is being rapidly extended to others.

Ascarids in swine.—This investigation led to the development of the present system of swine sanitation, which, on the basis of results reported from Illinois, is now saving about \$1,000,000 annually for the swine growers of the Middle West.

Texas fever tick.—Research on the life history of this parasite and on the standardization of the dip used for destroying ticks has been a basic factor in the tick-eradication campaign, making possible better cattle and better beef in the South and Southwest.

Fattening poultry.—This study, involving the feeding of over 100,000 chickens, showed the comparative value of different rations for producing high-quality poultry flesh and the best methods of feeding, and have been published in B. A. I. Bulletin 140.

Investigation of egg trade.—A survey showed heavy losses in eggs due to improper methods of handling on the farm and at country stores. Losses were estimated at 17 per cent of the total value, or \$45,000,000 a year. Studies developed the fact that one-third of this loss was due to blood rings, caused by the development of the embryo in the fertile egg. Removal of the male birds from the flock as soon as the hatching season is over and the segregation of young cockerels eliminate such losses.

Preserving eggs.—Various solutions and different containers for use in preserving eggs were tested, and the results of the study widely disseminated. It is estimated that not less than 300,000 persons have adopted some method of preserving eggs during periods of low prices and high production for use during periods of low production, resulting in a saving for this group of upward of \$1,000,000.

Violet ray and cod-liver oil as an aid to egg production.—It has been found that when chickens do not have access to direct sunlight it is very difficult to devise rations which will enable them to produce eggs unless the rations are supplemented with cod-liver oil or irradiation by ultra-violet rays is practiced. It has been demonstrated that feeding of 2 per cent of cod-liver oil with the ration produces better results than daily irradiation for 10 minutes.

Molting.—Molting in chickens is a large factor in the total annual egg production. Results of this inquiry show that approximately three-fourths of 1 per cent of a mixture of sodium sulphate, sodium thiosulphate, and flowers of sulphur is effective in increasing the annual egg production from 15 to 20 per cent. Assuming that this would result in increasing profits 10 per cent and that 10 per cent of raisers would use this compound, a net saving of \$2,000,000 a year would be effected.

Size and quality of eggs.—A study of the factors affecting egg size is in progress. It is indicated that the body weight of chickens shows a reduction as the result of continued inbreeding, which factor may have an influence on egg size. Fully 5 per cent of the one and three-quarters billion dozens of eggs produced each year in the United States are undersized and sell for from 10 to 12 cents per dozen less than full-sized eggs.

Egg shape.—This has been shown to be an inherited character. Losses resulting from breakage in marketing eggs of poor shape are estimated to amount to \$250,000 a year. The study has developed families of fowls laying desirably shaped eggs.

Soft pork.—All pork products from soft hogs are inferior and command lower prices. Probably a conservative estimate would place the annual loss to producers from this cause at \$1,000,000, while the total loss in the industry is very much greater. Research by the department and cooperating States has proved that feed is the principal cause of soft pork. The specific constituents of feeds responsible for softness are unsaturated fats or oils. Firmness of pork is found to be due to the synthesis of firm fat by the animal from carbohydrate and protein feeds. Conclusive results as to the influence on the character of fat have resulted from a study of various feeds and feed combinations under different conditions. It has been determined that soy beans exert a marked softening influence when used as feeds, making the soft-pork problem of great importance in those sections of the country where soy beans are utilized for swine food. Studies are in progress in the development of methods for the maximum utilization of soy beans in hog production which will not result in low-quality pork.

Quality and palatability of meat.—Preliminary results are bringing about a better understanding of the relation between market grade of meat animals, as determined by visual examination, and certain characteristics of meat as measured by more exact laboratory methods. The ineffectiveness or undesirability of such practices, as giving a short-grain feed to mature grass-fat cattle, allowing heifers and steers equal fattening periods, curing meats without temperature control, and preparing and cooking meat without adapting the method to the cut and the quality of meat, has been rather conclusively established. Considerable light has been thrown upon the subject of tenderness and palatability of dark-cutting beef, the comparative wastiness of steer and heifer beef, and the influence of age and castration on lamb meat. Methods of histological procedure for the special situations encountered in the study of meat have been developed and put into use. Indications are that the inheritance of an animal may have a vital influence upon the tenderness and palatability of its meat. The establishment of standards of quality and a clear knowledge of how they are obtained will promote confidence, satisfaction, and stability in the livestock industry. The results of this project will enable the consumer to obtain more satisfaction from his meat purchases. The producer will be able to plan his operations to meet consumer demand, and transactions in the meat trade will be handled more expeditiously and economically.

Goats' milk.—Study of the nutritive properties of goats' milk which make it especially valuable for the feeding of infants and young animals has indicated that there are nutritional differences between goats' milk and that of at least two of the leading dairy breeds of cattle. Comparisons which will show the relative vitamin, (A, B, C, and D), calcium, phosphorus, sugar, fat, protein, iron, iodine, and other constituents of these milks are now in progress. These will be followed with infant feeding tests at Johns Hopkins University.

BUREAU OF DAIRY INDUSTRY

The benefit of the research work of the Bureau of Dairy Industry to the consumer can probably best be indicated by a consideration of the part which dairy products play in the human diet and the enormous increase which has taken place in the production and consumption of such products during the past few years. The American people are spending between three and four billion dollars annually for dairy products, which provide approximately 38 per cent of the energy requirements of the human body. The consumption of milk in all its forms increased from 834 pounds per capita in 1918 to 1,040 pounds in 1926. This enlarged consumption required an increased production of about 33,000,000,000 pounds of milk. On the basis of average production conditions in 1918, it would have required over 8,000,000 additional dairy cows to meet the existing consumption demand, and it is safe to assume that the average family would have been under the necessity of expending a much larger proportion of its present food budget for dairy products than is now the case because of the increased cost of production, had not the Department of Agriculture and various State agencies, through the development of scientific and economical methods of breeding, feeding, management, selection, and care of dairy animals made it possible to so increase the average milk production per cow as to supply about 99 per cent of the existing consumptive requirements.

The work of the Bureau of Dairy Industry has been an important factor in meeting the increased public demand for dairy products through economical increase in production by the application of scientific methods; in the sanitary production, handling, and distributing of milk; in the development of new or improved methods of manufacture of dairy products; in the discovery of causes of deterioration of certain manufactured products; and in the development of new uses for dairy by-products.

The bureau's research in dairy sanitation deals with the fundamental factors in producing and preparing for the market milk and cream of high quality. In no other country in the world is the consumer so adequately protected from milk-borne infections. The discovery, adoption, and application to the dairy industry in the United States of sanitary principles has been without parallel. The average milk consumer can purchase milk on the open market with a feeling of safety. Such an assurance has led to the increased use of milk and other dairy products, resulting in the expansion of markets and a great increase in the per capita consumption of milk. Other work of the bureau which has served to increase the marketability of milk, and hence increase its use, includes investigations resulting in improved palatability, through the elimination of undesirable feed flavors and odors; increased satisfaction through the development of uniform characteristics of the product, such as cream line, whipping quality, and viscosity of cream, keeping quality, etc.

Studies in city milk plants have determined the effect of plant arrangement, types of machinery, and handling processes on the economy of operation. Through studies in bottle breakage in the milk plants alone, principles have been worked out which, if followed, will effect large savings. Economy in handling milk between producer and consumer is the basis of higher prices for the producer and lower costs to the consumer.

The bureau's investigational work in manufacture and utilization of dairy products and by-products vitally affects both producer and consumer. The manufacture of sweet-cream butter, which was developed in the bureau's laboratories and which has become an industry of tremendous importance, brings the producer a much higher price for his raw product and insures the consumer a safe manufactured article. Processes for the manufacture of cheeses, especially Swiss, Roquefort, and other so-called foreign cheeses, are providing an outlet for large quantities of milk and effecting a reduction in the cost to the consumer for these products. Similarly, the development of processes for the utilization of very large quantities of skim milk, the discovery of manufacturing defects in milk powder, condensed and evaporated milk, ice cream, and other dairy products is playing a tremendous part in the elimination of wastes, in increased profits to the producer, and in lower costs to the consumer.

Specific examples of benefits to producers and consumers as a result of research work of the Bureau of Dairy Industry are as follows:

Dairy sire introduction and investigation.—Results of investigations show that when purebred bulls were mated with cows of average production for the country as a whole, the daughters produced on an average 121 pounds more of butterfat than their dams. In one particular State this increase would amount to 1,936,000 pounds of butterfat. Estimating butterfat at 40 cents per pound, this single State would, as a result of this practice, have an additional revenue of \$774,400 per annum. This one State is only a fair example of the possibilities of the better-sire work.

Cheese manufacturing investigations.—One company making about 360,000 pounds of Swiss cheese annually, with the methods employed several years ago, obtained out of its total product only about 10 per cent of fancy and No. 1 grade. After introducing new methods developed by the bureau, about 90 per cent of its output is now of the two upper grades, representing an increased value of \$15,000. Similar results have been obtained in many other factories through the adoption of the new methods.

Butter and by-products investigations.—The value of 130,000,000 pounds of butter stored each year is probably increased \$5,000,000 through the elimination of "fishy" and other storage flavors, as a result of the work on the relation of acidity to deterioration of butter. By adopting the grain-curd-casein method one factory alone has reduced the labor cost and receives at least 2 cents per pound more for the product, or a total of about \$10,000 annually. One factory produced 1,000,000 pounds of concentrated sour milk in one year, with a value at the factory of \$32,000, from skim milk which would otherwise have been wasted. A factory has been established in which citric acid is made on a large scale by fermentation of cane sugar, following methods worked out by the department for obtaining citric acid through the fermentation of milk sugar, but data are not yet available as to the resultant financial returns.

Making American cheese in the southern Appalachians.—In 1926, \$80,000 in cash was paid to farmers in the southern mountain regions for milk, which in that section became a cash crop only after cheese factories had been established through the efforts of the Bureau of Dairy Industry.

Improving quality of American Cheddar cheese in Western States.—In 1927 the Western States made 20,000,000 pounds of cheese. It is estimated that improvement in the quality of this cheese, effected as a result of following methods recommended by the bureau, has increased its value one-half of 1 cent per pound, or a total for the whole output of \$100,000.

BUREAU OF PLANT INDUSTRY

The appropriations for the Bureau of Plant Industry are almost entirely for research work and fully half of the total is devoted to research on food crops. Although the benefit from such researches accrues more directly to the farmer than to the consumer, any improvement of the food crops of the Nation must be of benefit eventually to the food consumer. The underlying purpose of these investigations has been to achieve national progress in agriculture through intelligent appreciation of existing facts and through the development of new ideas directly or indirectly related to crop production and plant growth. It is recognized that no accurate monetary expression can be made of the economic gains more or less directly resulting from these research activities, but their annual financial value to the country as a whole is regarded as considerably more than fifty times as large as the total annual appropriations for the work of the bureau.

A few examples will serve to illustrate the importance of this research work to producers and consumers.

Among the first of the major activities of the bureau was the study of foreign cereals and the selection and introduction of certain important varieties for trial in the United States. The first introduction of a new grain upon a large scale was the establishment of the durum varieties of wheat, which are adapted to certain portions of the United States having severe climatic conditions, where the varieties of wheat previously grown were unsuited. For the past 15 years the increase in wheat production from the establishment of durum wheat as compared with the use of other varieties has been more than 20,000,000 bushels annually.

Potatoes make a very large and important contribution to the food supply of the Nation. No other food crop, so widely and extensively used, passes directly from the producer to the consumer without fabrication. Potato specialists, both pathological and horticultural, in the States where seed potatoes are extensively grown, are lending every aid to the improvement of the character and quality of the seed grown. The use of certified seed has without doubt been one of the chief factors in increasing the average per-acre production of the country during the past decade from about 85 bushels to slightly over 100 bushels per acre. The potato growers of the country have been saved millions of dollars annually through the use of certified and diseases-free seed.

Previous to the 1909 orange crop, the losses sustained by the California growers from the rotting of oranges in transit ranged from 8 to 20 per cent of the total shipment, averaging around 12 per cent. The investigational work of the bureau, which showed the necessity for careful handling of oranges, clearly demonstrated the feasibility of reducing the losses from rot in transit from the averages prevailing when the work was inaugurated to around 2 per cent. In addition

to the actual increase in quantity of sound oranges delivered in the markets, the unit value of the crop has been decidedly increased by the improved methods of handling, including more efficient refrigeration equipment and practice. As a result of the adoption of these improved practices, the general appearance and condition of the fruit are so superior at the time of delivery to the consumer at the market that its selling value is very much greater than was possible when so large a percentage of deterioration took place during the transit period.

The loss from plant diseases probably approximates one and one-half billion dollars annually. Some of these diseases are being most effectively fought through the discovery or development of cultural varieties immune or resistant to them. Among these may be mentioned the Marglobe, a wilt-resistant variety of tomato developed by the bureau in its breeding work. This variety is now produced almost exclusively in southeastern Florida and is being grown extensively for table fruit in New Jersey, Maryland, and parts of the Middle West and in other regions of the United States. Approximately 10,000 acres of Marglobe were grown in Dade County, Fla., in the winters of 1926-27 and 1927-28, which is almost the total tomato acreage of this county. The annual saving to this county alone from the use of this variety is about \$1,500,000.

During the past decade the mosaic disease of sugar cane has attracted world-wide attention and has been the subject of investigations in 22 cane-producing countries. This bureau has introduced into the United States new varieties of sugar cane that have proved to be resistant to the mosaic, and the cultivation of these varieties has rehabilitated the sugar-cane industry in Louisiana. The 1928 crop should be worth about \$21,000,000, as compared with only \$7,000,000 from a materially greater acreage in 1926. The prospects are that the crop being planted for the harvest of 1929 will be almost entirely of the mosaic-tolerating varieties, and that practically a normal acreage will be planted to canes destined to outyield the old varieties even as they were before mosaic had been introduced and become widespread. However, undiminished efforts are being continued to obtain varieties that may be more resistant to mosaic and to the other unfavorable conditions existing in parts of the sugar belt.

BUREAU OF CHEMISTRY AND SOILS

Sugar and sirup investigations.—Considerable work has been devoted to the development of methods for preventing the crystallization of cane and sorghum sirups and for securing general uniformity in quality. This has resulted in making available to the consumer cane and sorghum sirups of better and more uniform quality than previously existing types.

Attention has been given to determining the nature of the impurities in refined sugar which, although present in very small proportion, have a great influence in determining the suitability of different grades of refined sugar for various purposes. For instance, certain impurities detract from the suitability of granulated sugar for making certain types of confectionery. Basic information obtained on this subject has enabled consumers to select suitable grades of sugar more intelligently and has made it possible for producers to manufacture more consistently grades of sugar of the desired quality.

Investigation of the factors causing the production of raw cane sugar of poor refining quality has resulted in obtaining basic information which assists in the production of raw cane sugar of improved refining quality. While this work has been done primarily for the benefit of the sugar-cane grower and raw-sugar producer it reacts to the benefit of the refiner and the ultimate consumer.

In connection with studies in the diversification of maple products for the purpose of increasing market returns, a method has been devised for making maple cream of improved quality. This has not only afforded the producer a further market outlet for his maple products, in addition to the standard forms of sirup and sugar, with consequently greater profit, but has also been beneficial to the ultimate consumer by giving him an article of improved quality. Similar results may be expected from the investigations of color standards for maple sirup, which have placed the preparation of the master standards on a more secure and rational basis, thus insuring greater reliability in quality and uniformity in grade.

As a result of efforts of the Bureau of Chemistry and Soils to devise specialties for the domestic cane-sugar industry in Louisiana and to diversify products made from sugar-cane, a new product, known as cane cream, has been originated. This will not only tend to expand the market and increase the profits of the producer, but at the same time will provide a new and valuable addition to the food supply of the people.

Wheat chemistry.—Research work is under way to improve the quality of wheat by spacing the rows more widely. The amount of land sown to wheat in the United States each year is approximately 50,000,000 acres, for the planting of which about 75,000,000 bushels of wheat are required under existing planting practices. With the general adoption of the improved method of wider spacing of the rows it is estimated that a saving of half of this seed wheat could be accomplished. At the same time, by using this method the protein content of the wheat could be increased to an extent which would result in a net profit to the producer of \$4 per acre, and the consumer would benefit to a corresponding extent through having the higher content of protein in the wheat used for food.

Food conservation.—Studies on spoilage in canned foods, improvements in canning technique, and methods of brining and pickling have contributed to the elimination of improper practices, the maintenance of good quality, and the preservation and marketing of products which otherwise would have been unsalable. The benefit derived by the consumer from this type of work is incalculable.

Fruit and vegetable utilization.—Studies of new and improved methods of utilizing cull and surplus fruits and vegetables and of their by-products have been the basis of increased returns to the growers, extension of marketing seasons, and addition to the number and quality of valuable food products available to the consumer. In 1920 a single by-products manufacturing company reported payments to lemon growers' associations of from \$200,000 to \$250,000 for cull and surplus fruits, and the returns to lemon shippers have since increased to twice that amount. The annual return on orange by-products has been raised from one-fourth to three-fourths of a cent per pound, bringing in an annual return of at least \$200,000 to the orange growers.

Fruit maturity standards.—Extensive studies have been conducted in the development of maturity standards for oranges, grapefruits, avocados, cantaloupes, pomegranates, and raisins. This work has resulted in increased returns to the producer, a more stable market, and a higher quality of products for the consumer. The value of the orange maturity work to the orange industry for the seasons 1913-14 to 1919-20 is estimated at approximately \$4,000,000, and these benefits are still accruing to the industry. The ethylene-gas method of coloring citrus fruits developed by this bureau, and now almost universally used in the citrus industry for the coloration of mature citrus fruits, has proven more economical, more efficient, and more satisfactory as to handling and results than the old methods, and has eliminated the serious fire hazards attendant upon the use of the former methods.

Honey research.—While the chemical composition and food value of honey has been investigated in a small way by the department for many years, no specific provision was made for this project until Congress at the last session appropriated \$7,500 for this purpose. Previous investigations have related to the composition and methods for improving the quality of American honeys. The work under the new appropriation for honey research will have for its purpose the extension of present knowledge of the composition of American honeys and the devising of new methods for their utilization, thus affording a greater variety of honey products for the consumer and a wider and more profitable market for the producer.

Edible oils and fats.—Investigations of edible oils are made for the purpose of obtaining new and accurate data regarding the character, composition, and properties of the crude and refined products. These studies have furnished information which indicates the possible value of a number of hitherto disregarded by-products for oil production, and will include a determination of the uses for which the oils obtained therefrom may be adapted. In the case of cull avocados in California and Florida, it was found that the oil can be used for edible purposes and for making soap. Investigations are also under way for the detection of adulterants of fats and oils and of the products made from them.

Protein and nutrition investigations.—Research on the nutritive value of the proteins of different foods and feedstuffs show how the proteins of different grains, seeds, and other products used for food vary in their nutritive value and how the deficiencies of one foodstuff may be compensated for by using with it the proper quantity of some other foodstuff that is rich in the desired constituents. This is a question of tremendous importance not only in human nutrition but also to the stock raiser and husbandman. These researches have afforded data essential for the intelligent mixing of feeds and compounding of balanced rations, as well as a guide for the best selection of foods for human diet. The work on vitamins has furnished information of immediate value to the consumer in selecting such articles of foods and feeds as will best meet the vitamin requirements for normal health and nutrition. A study is also in progress to determine the effect of certain commercial processes used in food manufacture upon their vitamin content, the results of which are of direct value to the consumer in furnishing information that can be used for the preparation of foods with a minimum loss of vitamin value.

Insecticides and fungicides investigations.—Better and cheaper insecticides are being developed which will result in a great saving in the production of crops. New fumigants developed by the Bureau of Chemistry and Soils in cooperation with the Bureau of Entomology have been used to treat various foodstuffs infested with insects, with very promising results. For example, the mixture of ethylene dichloride and carbon tetrachloride replaces the dangerously inflammable and explosive carbon disulphide for killing weevils in grain. Ethyl formate has been used on a large scale by raisin packers for killing insects in this product. Ethylene oxide is coming into use for the fumigation of dried fruits, nuts, and other food products. It promises to replace hydrocyanic acid gas for the destruction of insect pests in food materials, since it leaves no toxic residue in the fumigated material and does not alter its taste or odor.

Improved methods of washing apples to remove the arsenical spray residue have enabled the apple exporters of this country to meet the British requirement of not more than 0.01 grain arsenic trioxide per pound of fruit. Previous to the development of these methods, the entire apple export industry of the United States, amounting in 1927 to over \$30,000,000, was jeopardized by threatened action on the part of the British and other European governments to forbid the importation of American apples.

Plant dust explosions and farm fires.—Losses running into the millions of dollars are caused annually by dust explosions and fires in flour mills, grain elevators, and other plants where agricultural productions are fabricated. The Bureau of Chemistry and Soils is investigating methods for reducing these losses. Spontaneous heating causes losses of farm products annually amounting to many millions of dollars, both in fires following spontaneous ignition and through the overheating and spoilage of stored agricultural products. The loss from fires in the United States reported to be caused by spontaneous ignition amounts to approximately \$20,000,000 a year according to figures and estimates compiled by actuaries of the National Board of Fire Underwriters, and this does not include any of the loss reported as from "unknown" causes, amounting to approximately \$200,000,000 a year, a considerable portion of which must have been due to spontaneous combustion. Studies are under way to determine the fundamental facts regarding this problem and develop practical means and methods for prevention. The practical application of the results accruing from this research will be of untold value in materially reducing the annual waste from dust explosions and the spontaneous heating of agricultural products.

Soil fertility investigations.—Studies have been made of the comparative effectiveness of various fertilizers on the production and quality of certain crops, including potatoes, sweet potatoes, sugar beets, sugar cane, citrus fruits, vegetables, strawberries, pecans, and peaches.

Studies are now being made of the influence of soil type and fertilizers on the culinary quality and composition of potatoes; the effect of fertilizer treatment on the fat and mineral content of pecans; the influence of soil type and fertilizer treatment, including some of the uncommon soil elements, on the edibility and quality of citrus and vegetable crops; the effect of fertilizer treatment on shipping and edible quality of peaches, and the influence of soil type and

fertilizer treatment on strawberry production and quality, both edible and shipping.

These studies concern the producer and consumer to the extent that the increased production and improvement of quality, both edible and shipping, represent savings of many thousands of dollars.

BUREAU OF ENTOMOLOGY

The work of the Bureau of Entomology affects very closely matters of food production through the protection of crops in the field and the resultant food products during their development and storage. The major part of the work of the bureau is of direct importance in the production of crops. In fact, its investigations have been the means of saving several commercial agricultural industries; for example, the development of control measures for such pests of apple as the San Jose scale and codling moth, the peach borer and curculio attacking the peach, the Colorado potato beetle and leafhopper of the Irish potato, the Hessian fly injurious to wheat, scale insects attacking citrus, etc., must be credited to an important degree with the continued commercial culture of these food crops. Protection of cattle, sheep, swine, poultry, etc., against insects has long been an important part of the bureau's work and contributes very directly to better and cheaper foods. No inconsiderable benefit of the bureau's work relates to protection from insect attack of crops in the home vegetable garden and orchard, which in the aggregate is a very important source of food for that portion of the population living outside the congested city limits. While many direct benefits of the bureau's work on food products may thus be cited, a large portion of its activities affects food crops more or less indirectly and which are difficult of estimation with exactness. Among these are included fundamental investigations of insecticides, insect physiology, insect behavior, the utilization of beneficial insects, and such emergency investigations of great potential importance as those relating to the control of the Japanese beetle, European corn borer, Mexican bean beetle, etc.

Some striking examples of the effect of the work of the Bureau of Entomology on food crops are shown in the statements which follow:

Citrus insects in the Gulf region.—This project is concerned with the development of control methods for citrus insects in humid regions. The major achievement has been the discovery of lubricating oil emulsions as insecticides. These are now the standard citrus treatment in humid regions and have resulted in large savings. Moreover, their use has been adopted in many other fields, as sprays for ornamental trees, deciduous-fruit trees, etc., greatly influencing the economic production of citrus and certain deciduous fruits.

Control of potato leafhopper.—Investigations conducted under this project, which were completed in 1927, proved that the potato leafhopper can be effectively controlled by applications of Bordeaux mixture in the form of spray or dust. This pest, which is listed among the first 10 of the most destructive insects of this country, is widely distributed and has caused vast losses to potato growers, sometimes approaching total destruction of the crop in certain sections. The standardizing of the remedy developed by the bureau has been of great value in stabilizing potato production in the important area infested by this insect.

Nicotine dust as a control for vegetable pests.—The investigations conducted under this project have been completed and have shown conclusively that nicotine dust can be satisfactorily used as a means of controlling various plant lice affecting vegetable crops under conditions where the temperatures are sufficiently high to produce satisfactory volatilization of the nicotine. The results of these investigations have been made available to growers and the usefulness of this work is demonstrated by the fact that nicotine dust has in the past few years become one of the standard remedies for plant lice. The general adoption of this remedy has resulted in large savings to producers of truck and other crops.

Apple codling moth investigations.—When it was determined that the standard spray treatments for preventing damage by the apple codling moth left a residue on the fruit, harmful to the consumer, it was necessary to conduct new investigations to determine other methods for controlling this pest. In 1925 investigations to develop schedules for the application of a poison which would obviate the spray residue were undertaken. These consist of testing substitutes and the revision of spraying and dusting schedules which will be effective in controlling the codling moth and at the same time leave the matured fruit free from objectionable poison sprays when harvested. The investigations have not been completed. Work on other phases of the codling moth has in years past resulted in inestimable saving and has made possible the large commercial apple industry which furnishes this valuable fruit to consumers at a moderate price.

Peach-tree borer.—Studies by the Bureau of Entomology have indicated that paradichlorobenzene is, under certain conditions, 95 to 98 per cent effective in controlling the peach-tree borer. This discovery has resulted in large savings to the peach industry and directly influences the prices that must be paid by consumers.

Hessian fly.—Present work by the Bureau of Entomology under this project deals with studies on parasites of the Hessian fly and includes a technical survey service which forms a basis of annual control measures to be adopted by the farmers. The results so far obtained have made it possible to recommend means of control which have greatly reduced losses of wheat from this pest and thus assist in stabilizing the production of this valuable food crop.

Insects affecting poultry.—Investigations by the bureau with reference to poultry parasites have led to the development and general use of control measures which have effected a tremendous saving to both the producer and consumer of poultry products. Probably the most striking accomplishment in this connection has been the discovery and general adoption of sodium fluoride for the control of poultry lice.

Stored-grain insects.—Studies are in progress for the determination of methods for the control of insects attacking grain held on the farm after harvesting, in the mill, at the elevator, and at every subsequent stage of the handling of grain and its products, including the use of fumigants, development of sanitary methods for mills, elevators, and warehouses, and improvements in packaging of various cereals in order to make them safe from insect attack. These investigations undoubtedly result in vast savings since they serve effectively to

protect food products against the infestation of insects, which, if left uncontrolled, would bring about incalculable losses. In addition, these investigations tend to insure to the consumer cereal foods free from insect infestation during all periods of the year.

BUREAU OF BIOLOGICAL SURVEY

Rabbit experiments.—This bureau maintains a rabbit experiment station in California for the purpose of conducting investigations to develop reliable information for rabbit breeders and for those contemplating engaging in the rabbit industry. Studies are made as to the best methods of breeding, feeding, and housing domestic rabbits to produce meat and fur of high quality, and as to the most profitable breeds to keep. Methods for the eradication, prevention, and control of diseases are also studied. Through cooperation with the Bureau of Home Economics, cooking recipes have been worked out and have been made available to the public on the preparation of rabbit meat for the table.

Alaska reindeer investigations.—Investigations are being conducted in Alaska having to do with improved methods of handling reindeer, with grazing conditions affecting them, and with the prevention and control of diseases with which they are afflicted. Through cooperation with the Bureau of Animal Industry, Bureau of Home Economics, and Bureau of Agricultural Economics, studies in the cutting, handling, and cooking of reindeer meat and of the chemical composition and vitamin contents of the meat have been conducted.

BUREAU OF PUBLIC ROADS

Agricultural engineering.—Practically all the investigational work now in progress on farm irrigation and drainage, farm structures and farm mechanical equipment, and other phases of agricultural engineering have for their purpose, either directly or indirectly, the reduction of cost of the production of food and other essential agricultural products, or the storage and transportation of these products in such a manner as to bring them to the consumer in better condition. As examples of this type of work may be cited, in addition to the better-quality and lower-cost factors incident to the adoption of improved irrigation and drainage practices, the development of better types of sweet-potato storage houses, the use of which has materially reduced the losses of sweet potatoes in storage and permitted the placing of a product of better quality on the market; studies of the combined harvester-thresher, which indicate that where this machine has been adopted it has reduced the cost of harvesting grain at least 15 cents per bushel; studies of the transportation of perishable farm products, which have resulted in increasing efficiency in handling these products and in bringing them to market in better condition in both hot and cold weather, etc.

BUREAU OF AGRICULTURAL ECONOMICS

A very large part of the work of this bureau aims to bring the producer and consumer into closer relation. Studies are made and information disseminated on methods of handling, grading, packing,

and marketing farm products so as best to meet consumer demand. This work covers all important farm products. Producers are instructed with regard to the type of products which consumers want. This renders a service both to producer and consumer. The market information service keeps the producer informed with regard to the demand for various products in the receiving markets. This enables the producer to send his products to the market where there is the greatest demand, thus preventing alternate gluts and shortages in the market. This work is of value to the consumer as it keeps a steady flow of products to the markets, prevents waste, and tends to equalize prices. Any influence which helps to make marketing methods more efficient benefits the consumer by giving him better products at lower prices.

A very important project of this bureau is the formulation of standards for farm products and the educational work necessary to insure their use. This work is of particular value to the consumer since it enables him to buy his products on the basis of Federal standards of quality. It benefits the consumer indirectly also in that it prevents the shipping of large quantities of inferior products and eliminates waste. Standards have been prepared for more than 40 important fruits and vegetables. These are used in the market information and inspection services, and in a number of cases the standards have been adopted and made mandatory by State law. Standardization work has been done on livestock, meats and wool, dairy and poultry products, hay, beans, etc. In addition, under special legislation, mandatory standards have been promulgated for cotton, wheat, corn, oats, rye, grain sorghums, feed oats and mixed feed oats, and barley. There is much work still to be done in educating both producer and consumer as to the advantages of buying and selling on the basis of recognized standards.

BUREAU OF HOME ECONOMICS

The foods research work of the Bureau of Home Economics is planned directly to furnish information to the consumer in the wise utilization of agricultural products as food. The projects listed below are planned definitely to this end. It is difficult to estimate the value of this work to the public. The returns come to the industry on the one side in directing the easier utilization of agricultural products and to the consumer on the other in turns of wise utilization to better health which results from the use of food in the right combinations and amounts.

Examples of the work of this bureau are indicated by the following projects, completed and under way:

Assembling data on composition of American food materials.—This is a continuing project, bringing together all available data on proximate composition of food, studying these data statistically, and making available the results. These data are basic in all dietary work used by nutrition workers and dietitians the country over, and therefore make very definite contribution to health which would be difficult to measure. The information obtained is used by food industries in presenting their products throughout the country, and makes unnecessary a great deal of analytical work previously done by many industries, thereby saving directly considerable sums.

Vitamin content of foods.—The extensive findings on the relation of vitamin to health can be applied only as the vitamin content of common foods becomes known. This project has been undertaken to check methods for determining vitamin content of foods, to assemble data on vitamin content from studies already made, and to plan additional studies needed to supplement present information. These studies have a very direct relation to human health, as, for example, in the prevention of rickets and pellagra, two diseases definitely known to be prevented by the presence of certain vitamins in the diet, as well as with respect to certain conditions of well-being determined by the more general presence of all vitamins in food.

Food utilization studies.—The experimental kitchen of the Bureau of Home Economics has tested foods referred to it by other bureaus of the department and cooperative agricultural agencies. These studies have made possible the wise utilization of the products investigated, have called their use to the attention of the housewife, and have in certain cases led to the wise use of certain agricultural by-products hitherto allowed to go to waste.

Factors involving the palatability of meat.—In cooperation with the Bureau of Animal Industry, studies have been made seeking to correlate productive factors with palatability. As a by-product of this investigation several circulars on cooking meat have been prepared. This alone should result in a considerable saving, since much meat has been wasted in this country through poor methods of preparation.

Food preparation.—The experimental kitchen of this bureau has already checked recipes and prepared recipes for bulletins and circulars for the radio and for use in answering letters which come from homemakers and home demonstration agents. This work is of value in encouraging wise use of food, decreasing waste, and promoting nutrition through more palatable and better prepared food.

Home preservation of food.—The bureau has made studies of methods of home preservation of food. The results are disseminated by bulletins and letters and have accomplished actual saving of food products through the adoption of methods for preventing spoilage.

Dietary studies.—Studies have been made of the food habits of farm families which have shown these families how a larger proportion of their food supply may be produced to advantage. Both farm and city dietary studies have been made and are still in progress, with a view to getting a picture of the food habits of the people as a basis for production programs. This study has been extended to various institutional groups, including college dormitories and children's institutions, so as to show them how these groups may be better fed at lower cost.

Pellagra studies.—Investigations have been undertaken in certain counties in South Carolina where pellagra has been particularly bad to show what foods may be used to prevent this disease, which has caused considerable economic loss to the community.

Estimated allocation of Federal funds for agricultural research, food research, and poultry and eggs research, administered by the Department of Agriculture, fiscal years 1929 and 1930 (pursuant to Senate Resolution 348, 70th Congress)

Item	Estimated allocations (expenditures and obligations) for research					
	Fiscal year 1929			Fiscal year 1930		
	All re-search	Food re-search	Poultry and eggs re-search	All re-search	Food re-search	Poultry and eggs re-search
General department administration and overhead-----	\$473, 178	\$26, 498	\$1, 183	\$514, 178	\$28, 280	\$1, 214
Office of experiment stations: Payments to States and Hawaii for research at agricultural experiment stations, under Hatch, Adams, and Purnell Acts-----	3, 840, 000	2, 084, 139	230, 837	4, 335, 000	3, 215, 000	232, 000
Insular experiment stations-----	257, 594	250, 594	3, 500	243, 840	237, 000	3, 500
General administrative expenses-----	139, 310	135, 000	7, 800	155, 000	150, 000	8, 500
	4, 236, 904	3, 469, 733	242, 137	4, 733, 840	3, 602, 000	244, 000
Weather Bureau: Meteorological and climatological research-----	129, 430	-----	-----	156, 930	-----	-----
Bureau of Animal Industry: General administrative expenses-----	11, 986	2, 612	1, 603	11, 909	2, 490	1, 777
Tuberculosis investigations-----	31, 400	31, 400	-----	31, 400	31, 400	-----
Animal husbandry-----	-----	-----	-----	-----	-----	-----
Swine investigations-----	61, 820	57, 000	-----	61, 820	57, 000	-----
Sheep and goat investigations-----	87, 758	27, 758	-----	92, 920	32, 000	-----
Horse and mule investigations-----	39, 110	-----	-----	39, 110	-----	-----
Genetic research-----	21, 350	11, 000	-----	21, 350	11, 000	-----
Maintenance of livestock experiment farm, Beltsville, Md.-----	44, 970	30, 970	-----	54, 970	40, 970	-----
Beef-cattle investigations-----	131, 550	111, 550	-----	80, 720	70, 720	-----
Poultry investigations-----	111, 650	111, 650	111, 650	116, 450	116, 450	116, 450
Nutrition research-----	29, 210	29, 210	-----	29, 210	29, 210	-----
Meat investigations-----	42, 890	42, 890	-----	17, 890	17, 890	-----
Diseases of animals-----	-----	-----	-----	-----	-----	-----
Miscellaneous pathological investigations-----	17, 517	10, 400	-----	17, 517	10, 400	-----
Pathological investigations of poultry diseases-----	7, 065	7, 065	7, 065	21, 950	21, 950	21, 950
Miscellaneous biological investigations-----	10, 980	8, 000	-----	10, 980	8, 000	-----
Pathological investigations of anaplasmosis-----	12, 265	12, 265	-----	12, 265	12, 265	-----
Index catalogue and collection of parasites-----	9, 270	6, 000	-----	9, 270	6, 000	-----
Investigation of poultry parasites-----	12, 195	12, 195	12, 195	12, 195	12, 195	12, 195
Investigation of swine parasites-----	15, 540	15, 000	-----	15, 540	15, 000	-----
Investigation and control of ruminant parasites-----	81, 900	31, 900	-----	87, 438	37, 900	-----
Investigation of horse parasites-----	9, 590	-----	-----	9, 590	-----	-----
Investigation of miscellaneous parasites-----	15, 930	10, 000	-----	16, 030	10, 000	-----
Investigation of treatment of livestock for internal and external parasites-----	13, 245	12, 000	-----	13, 245	12, 000	-----
Breeding and feeding small experimental animals for disease research-----	9, 270	8, 000	-----	9, 270	8, 000	-----
Investigation and control of bovine abortion-----	54, 345	50, 000	-----	92, 500	88, 000	-----
Investigation of stock poisoning by plants-----	25, 990	22, 000	-----	25, 990	22, 000	-----
Hog cholera-----	-----	-----	-----	-----	-----	-----
Investigation of methods of producing immunization against hog cholera-----	17, 250	16, 800	-----	17, 500	16, 800	-----
Investigation of mode of dissemination of hog cholera-----	12, 960	12, 000	-----	13, 210	12, 400	-----
Meat inspection: Investigation of wholesomeness and nutritive value of viscera-----	13, 375	13, 375	-----	13, 375	13, 375	-----
Experiments in livestock production in southern United States-----	54, 000	50, 000	-----	43, 500	41, 000	-----
Experiments in livestock production in western United States-----	21, 435	18, 435	-----	22, 035	19, 035	-----

Estimated allocation of Federal funds for agricultural research, food research, and poultry and eggs research, administered by the Department of Agriculture, fiscal years 1929 and 1930 (pursuant to Senate Resolution 348, 70th Congress)—Contd.

Item	Estimated allocations (expenditures and obligations) for research					
	Fiscal year 1929			Fiscal year 1930		
	All re-search	Food re-search	Poultry and eggs re-search	All re-search	Food re-search	Poultry and eggs re-search
Bureau of Animal Industry—Continued.						
Special corn-borer research (study of feeding values and feeding practice in connection with concentrates and roughages other than corn)	\$10,000	-----	-----	\$10,000	-----	-----
Special barley investigations (feeding experiments with diseased barley grain)	9,937	-----	-----	11,947	-----	-----
	1,047,753	\$771,475	\$132,513	1,043,106	\$775,450	\$152,372
Bureau of Dairy Industry:						
General administrative expenses	66,293	66,293	-----	67,000	67,000	-----
Dairy investigations—						
Dairy manufacturing investigations	58,107	58,107	-----	58,107	58,107	-----
Dairy herd improvement	65,033	65,033	-----	71,533	71,533	-----
Dairy cattle breeding	56,099	56,099	-----	70,666	70,666	-----
Ice-cream investigations	12,438	12,438	-----	12,438	12,438	-----
Butter and by-products	19,892	19,892	-----	22,392	22,392	-----
Condensed milk and milk powder	36,379	36,379	-----	39,652	39,652	-----
Bacteriology and chemistry of milk	20,186	20,186	-----	20,270	20,270	-----
Nutrition of dairy cows	39,875	39,875	-----	42,934	42,934	-----
Cheese manufacturing investigations	23,470	23,470	-----	33,503	33,503	-----
Dairy sanitation research	13,170	13,170	-----	13,270	13,270	-----
Milk plant management	14,714	14,714	-----	14,714	14,714	-----
Market milk and cream	9,163	9,163	-----	9,163	9,163	-----
Maintenance of dairy experiment farm, Beltsville, Md.	104,248	104,248	-----	111,858	111,858	-----
Field station, Woodward, Okla.	12,300	12,300	-----	12,300	12,300	-----
Dairy and livestock experiment station, Tennessee				50,000	50,000	-----
Experiments in dairying in western United States	38,565	38,565	-----	38,465	38,465	-----
Agricultural investigations in cooperation with South Carolina Experiment Station	39,458	39,458	-----	40,000	40,000	-----
	629,390	629,390	-----	728,265	728,265	-----
Bureau of Plant Industry:						
General administrative expenses	151,492	72,686	-----	155,250	84,870	-----
Mycology and disease survey—						
Disease survey	30,262	30,262	-----	29,872	29,872	-----
Mycological investigations	22,064	22,064	-----	22,628	22,628	-----
Investigation of mushroom diseases	5,229	5,229	-----	6,000	6,000	-----
Forest pathology—						
Diseases of forest trees and forest products	102,080	-----	-----	137,080	-----	-----
Diseases of shade trees, shrubs, and chestnut orchards	55,980	-----	-----	57,972	-----	-----
Plant nutrition investigations	17,990	17,990	-----	17,990	17,990	-----
Cotton production and diseases—						
Breeding of new and desirable types of cotton	79,342	-----	-----	79,827	-----	-----
Cotton diseases	26,330	-----	-----	36,033	-----	-----
Egyptian cotton breeding	24,495	-----	-----	24,640	-----	-----
Rubber, fiber, and other tropical plants—						
Acclimatization and adaptation of tropical and subtropical plants	47,555	-----	-----	47,965	-----	-----
Rubber production investigations	101,823	-----	-----	77,877	-----	-----
Fiber-plant investigations	33,828	-----	-----	34,158	-----	-----
Drug, poisonous, and oil plants	37,766	-----	-----	37,700	-----	-----
Investigations in nematology and agricultural technology	57,220	-----	-----	57,900	-----	-----
Seed testing	46,195	-----	-----	46,696	-----	-----

Estimated allocation of Federal funds for agricultural research, food research, and poultry and eggs research, administered by the Department of Agriculture, fiscal years 1929 and 1930 (pursuant to Senate Resolution 348, 70th Congress)—Contd.

Item	Estimated allocations (expenditures and obligations) for research					
	Fiscal year 1929			Fiscal year 1930		
	All re-search	Food re-search	Poultry and eggs re-search	All re-search	Food re-search	Poultry and eggs re-search
Bureau of Plant Industry—Continued.						
Cereal crops and diseases—						
Cereal agronomy, including investigations in wheat, oats, barley, rice, grain sorghums, flax, and corn	\$221,150	\$99,050	-----	\$253,535	\$132,060	-----
Cereal pathology, including investigations of sac and imperfect fungi, bacterial diseases, virus diseases, rust, and smut	169,910	144,458	-----	190,861	155,179	-----
Tobacco investigations	69,870	-----	-----	70,310	-----	-----
Sugar plants—						
Sugar cane	115,010	115,010	-----	114,310	114,310	-----
Sugar beets	101,117	101,117	-----	283,316	283,316	-----
Botany—						
Economic botany	25,920	(1)	-----	25,927	(1)	-----
Weed-control investigations	7,045	(1)	-----	7,240	(1)	-----
Blueberry investigations	6,515	6,515	-----	6,193	6,193	-----
Grass investigations	14,430	(1)	-----	14,440	(1)	-----
Dry-land agriculture investigations	361,105	180,552	-----	333,900	166,950	-----
Western irrigation agriculture investigations	145,191	50,820	-----	145,600	50,960	-----
Horticultural crops and diseases—						
General plant pathology investigations	43,985	43,985	-----	44,350	44,350	-----
Fruit diseases	208,684	208,684	-----	303,840	303,840	-----
Diseases of vegetables and ornamentals	170,203	152,930	-----	183,005	155,732	-----
Date culture and breeding	66,718	66,718	-----	66,398	66,398	-----
Citrus breeding and testing	16,371	16,371	-----	26,686	26,686	-----
Smyrna fig and miscellaneous crop physiology and breeding investigations	10,925	10,925	-----	11,361	11,361	-----
Plant physiology investigations	15,326	15,326	-----	16,046	16,046	-----
Nut investigations	44,929	44,929	-----	90,840	90,840	-----
Physiological investigations related to fruit and vegetable handling, transportation, and storage	111,327	111,327	-----	163,565	163,565	-----
Grape production investigations	31,437	31,437	-----	31,217	31,217	-----
Fruit production investigations	57,736	57,786	-----	57,788	57,788	-----
Fruit improvements through breeding and selection	31,895	31,895	-----	31,785	31,785	-----
Fruit and vegetable utilization	36,550	36,550	-----	38,190	38,190	-----
Truck crop production and improvement	62,959	62,959	-----	63,159	63,159	-----
Irish potato investigations	33,514	33,514	-----	53,334	53,334	-----
Ornamentals and landscape gardening	34,827	-----	-----	35,507	-----	-----
Nursery stock investigations	22,685	5,670	-----	22,660	5,665	-----
Arlington Experiment farm	60,160	20,000	-----	60,000	20,000	-----
Foreign plant introduction—						
Foreign explorations and experimenters' service	206,360	103,180	-----	194,972	97,486	-----
Plant geography	8,578	4,289	-----	8,228	4,114	-----
Forage crops and diseases—						
Alfalfa investigations	41,828	(1)	-----	52,433	(1)	-----
Clovers, soy beans, and other legumes	74,249	(1)	-----	75,386	(1)	-----
Fine turf investigations	8,189	-----	-----	8,338	-----	-----
Pastures and ranges, including miscellaneous grasses	34,682	(1)	-----	35,221	(1)	-----
Sorghum investigations	13,231	(1)	-----	13,437	(1)	-----
Forage crop diseases	10,085	(1)	-----	20,180	(1)	-----
Biophysical laboratory—						
Investigation of mechanism of heredity and factors influencing plant growth	37,632	18,816	-----	36,000	18,000	-----

¹ Indirect relation to food production.

Estimated allocation of Federal funds for agricultural research, food research, and poultry and eggs research, administered by the Department of Agriculture, fiscal years 1929 and 1930 (pursuant to Senate Resolution 348, 70th Congress)—Contd.

Item	Estimated allocations (expenditures and obligations) for research					
	Fiscal year 1929			Fiscal year 1930		
	All re-search	Food re-search	Poultry and eggs re-search	All re-search	Food re-search	Poultry and eggs re-search
Bureau of Plant Industry—Continued:						
Special corn borer research—						
Cultural and breeding investigations (corn)-----	\$25,000	(1)	-----	\$25,000	(1)	-----
Forage crops in corn-borer regions-----	30,000	(1)	-----	30,000	(1)	-----
Smelter fumes investigations—effect on vegetation-----	12,500	(1)	-----	15,000	(1)	-----
	3,644,529	\$1,923,044	-----	4,129,151	\$2,369,884	-----
Forest Service:						
Forestry research, exclusive of range investigations-----	980,003	-----	-----	1,136,695	-----	-----
Range investigations-----	52,680	(1)	-----	67,000	(1)	-----
	1,032,683	-----	-----	1,203,695	-----	-----
Bureau of Chemistry and Soils:						
General administrative expenses-----	58,980	10,000	-----	58,540	10,000	-----
Agricultural investigations—						
Carbohydrate investigations-----	42,250	33,250	-----	36,750	35,250	-----
Crop chemistry investigations-----	16,648	10,750	-----	17,318	10,750	-----
Food conservation-----	72,253	72,253	\$450	74,253	74,253	\$3,600
Fruit and vegetable utilization and fruit maturity studies-----	40,701	40,701	-----	42,701	42,701	-----
Honey investigations-----	-----	-----	-----	7,500	7,500	-----
Utilization of industrial farm products-----	41,507	-----	-----	43,507	-----	-----
Lignin research-----	9,855	-----	-----	10,855	-----	-----
Oil, fat, and wax investigations-----	17,515	8,700	-----	18,515	9,200	-----
Protein and nutrition investigations-----	34,171	34,171	-----	35,171	35,171	-----
Color and farm waste investigations-----	77,721	16,500	-----	78,000	26,500	-----
Syrup and sugar investigations-----	37,344	37,344	-----	37,600	37,600	-----
Insecticide and fungicide investigations-----	48,300	48,300	-----	83,765	83,765	-----
Plant dust explosions and farm fires-----	55,043	12,215	-----	51,500	12,100	-----
Naval stores research-----	15,435	-----	-----	32,000	-----	-----
Soil chemical investigations-----	33,720	(1)	-----	36,100	(1)	-----
Soil physical investigations-----	18,075	(1)	-----	18,100	(1)	-----
Fertilizer production investigations-----	347,724	(1)	-----	336,500	(1)	-----
Soil survey-----	268,000	(1)	-----	274,000	(1)	-----
Soil erosion investigations-----	40,000	(1)	-----	120,000	(1)	-----
Soil microbiology investigations-----	43,040	(1)	-----	43,400	(1)	-----
Soil fertility investigations-----	131,226	45,000	-----	159,000	50,000	-----
Special corn-borer research (investigation of economic utilization of cobs, stalks, and other corn waste, and study of insecticides and repellents for use in corn-borer control)-----	20,000	(1)	-----	30,000	(1)	-----
Smelter fumes investigations-----	25,000	(1)	-----	25,000	(1)	-----
	1,494,498	369,184	450	1,670,075	434,790	3,600
Bureau of Entomology:						
General administrative expenses-----	87,018	35,000	-----	91,000	36,400	-----
Deciduous fruit insects—						
Apple insects-----	61,750	61,750	-----	61,750	61,750	-----
Peach insects-----	23,780	23,780	-----	38,780	38,780	-----
Grape insects-----	6,095	6,095	-----	6,095	6,095	-----
Nut insects-----	30,235	30,235	-----	30,235	30,235	-----
Orchard insecticides and spraying machinery-----	18,550	18,550	-----	18,550	18,550	-----
Orchard insect survey-----	4,025	4,025	-----	4,025	4,025	-----
Blueberry maggot-----	17,155	17,155	-----	17,155	17,155	-----
Japanese beetle research-----	151,450	75,725	-----	149,240	74,620	-----
Asiatic beetle research-----	16,170	-----	-----	16,170	-----	-----
Plant disinfection investigations-----	10,580	-----	-----	15,790	-----	-----
Subtropical plant insects—						
Citrus insects in Gulf region-----	14,711	14,711	-----	14,711	14,711	-----
Greenhouse insects-----	18,405	-----	-----	18,405	-----	-----
Bulb insects-----	15,440	-----	-----	15,440	-----	-----
Fruit flies in Hawaii-----	8,025	8,025	-----	8,025	8,025	-----
Fruit flies in Canal Zone-----	3,740	3,740	-----	3,740	3,740	-----

¹ Indirect relation to food production.

Estimated allocation of Federal funds for agricultural research, food research, and poultry and eggs research, administered by the Department of Agriculture, fiscal years 1929 and 1930 (pursuant to Senate Resolution 348, 70th Congress)—Contd.

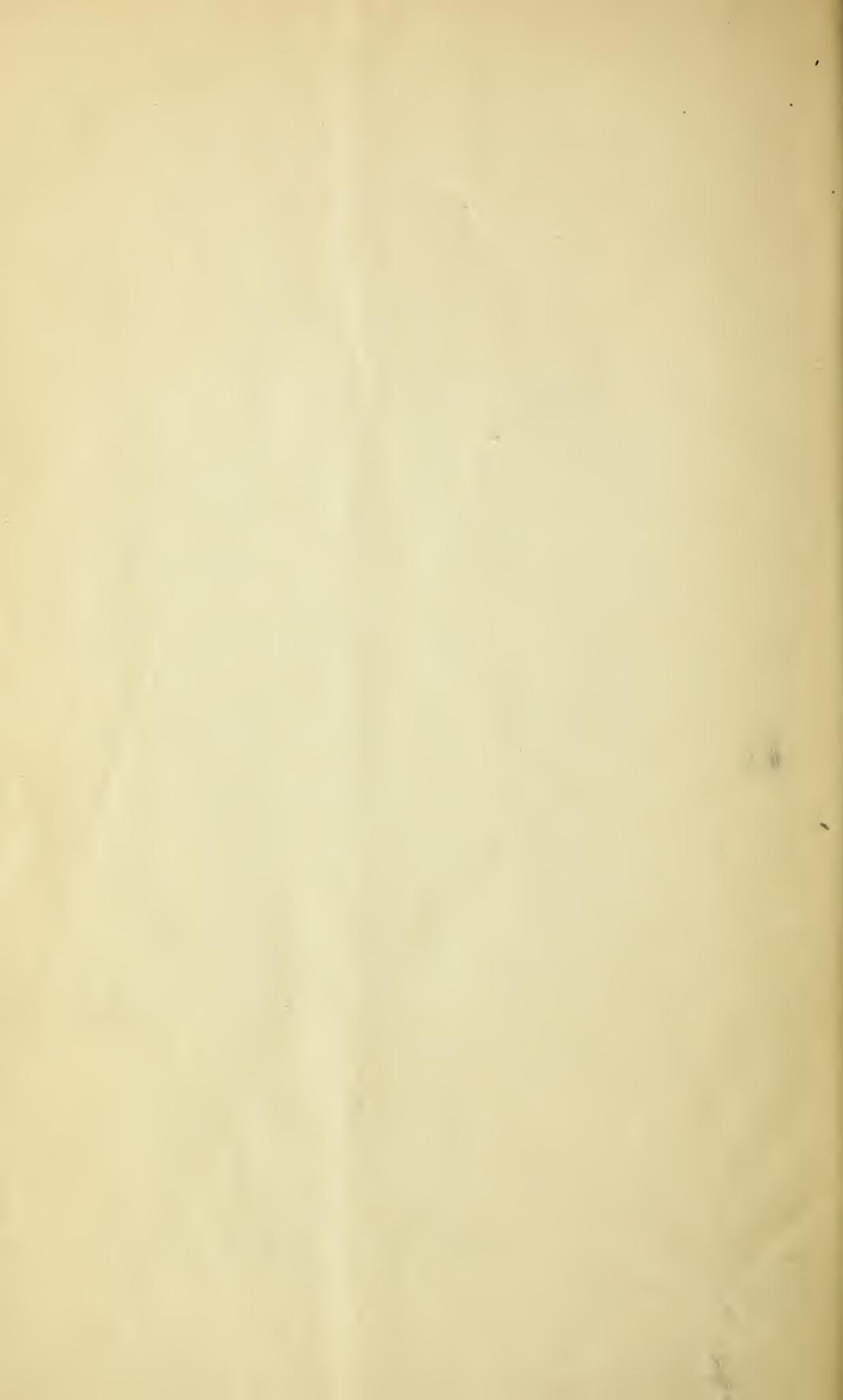
Item	Estimated allocations (expenditures and obligations) for research					
	Fiscal year 1929			Fiscal year 1930		
	All re-search	Food re-search	Poultry and eggs re-search	All re-search	Food re-search	Poultry and eggs re-search
Bureau of Entomology—Continued.						
Subtropical plant insects—Continued.						
Insects affecting miscellaneous ornamentals	\$13,884			\$13,884		
Citrus insects in California	5,075	\$5,075		9,235	\$9,235	
Mexican fruit worm	35,860	35,860		35,860	35,860	
Parlatoria date scale	3,700	3,700		3,700	3,700	
Truck crop insects—						
Miscellaneous truck crop insects	64,727	64,727		64,760	64,760	
Pea insects	8,760	8,760		8,760	8,760	
Sweet potato weevil	42,524	42,524		42,557	42,557	
Berry insects	5,370	5,370		7,370	7,370	
Soil insects	28,442	28,442		28,475	28,475	
Sugar-beet insects	30,111	30,111		48,111	48,111	
Tobacco insects	27,627			27,627		
Bean insects	34,700	34,700		39,700	39,700	
Mushroom insects	6,200	6,200		6,200	6,200	
Forest insects	193,360			194,000		
Cereal and forage insects—						
Cereal insects	35,250	17,625		35,250	17,625	
Forage insects	55,645	(1)		58,645	(1)	
Grasshopper control	28,980	14,490		28,980	14,490	
Alfalfa weevil	26,485	(1)		26,485	(1)	
Hessian fly	35,310	35,310		35,310	35,310	
Chinch bug	17,770	8,885		17,770	8,885	
European corn-borer research	227,320	(1)		227,320	(1)	
Sugar-cane and rice insects	32,860	32,860		32,860	32,860	
Cotton insects	287,120			303,120		
Insects affecting man and animals—						
Insects affecting man	13,820			13,820		
Insects affecting cattle	44,120	44,120		44,020		
Insects affecting poultry	1,000	1,000	\$1,000	1,000	1,000	\$1,000
Insects affecting sheep and goats	24,860	24,860		24,860	24,860	
Insects affecting other mammals and birds	200	200		200	200	
Stored products insects—						
Bean-weevil investigations	10,272	10,272		10,272	10,272	
Stored-grain insects	20,993	20,993		25,993	25,993	
Dried-fruit insects	15,333	15,333		15,333	15,333	
Household insects	4,162			4,162		
Cold-storage experiments	2,765	2,765		2,765	2,765	
Fumigation experiments	1,375	1,375		1,375	1,375	
Taxonomy and interrelations of insects	140,000	6,000		145,000	6,000	
Bee culture	54,337	54,337		54,400	54,400	
Special leaf-hopper and curly-top research	10,000	10,000		69,374	69,374	
Special corn-borer research (introduction and establishment of parasitic and predacious enemies of corn borer as a means of control)				40,000		
	2,079,446	864,685	1,000	2,257,664	973,576	1,000
Bureau of Biological Survey:						
General administrative expenses	11,000			13,200		
Food habits of birds and other animals, including eradication methods	88,382	(1)		99,610	(1)	
Production of fur-bearing animals—						
Production of rabbits for meat and fur	12,500	6,250		12,500	6,250	
Miscellaneous investigations of fur-bearing animals	38,171			38,700		
Biological investigations of wild-animal life	49,800	(1)		56,800	(1)	
Investigations of migratory birds	19,300	(1)		20,800	(1)	
Reindeer investigations	24,412	24,412		24,145	24,145	
Upper Mississippi wild-life refuge	2,000	(1)		2,000	(1)	
Migratory-bird conservation refuges				26,000	(1)	
	245,565	30,662		293,755	30,395	

¹ Indirect relation to food production.

Estimated allocation of Federal funds for agricultural research, food research, and poultry and eggs research, administered by the Department of Agriculture, fiscal years 1929 and 1930 (pursuant to Senate Resolution 348, 70th Congress)—Contd.

Item	Estimated allocations (expenditures and obligations) for research					
	Fiscal year 1929			Fiscal year 1930		
	All research	Food research	Poultry and eggs research	All research	Food research	Poultry and eggs research
Bureau of Public Roads:						
General administrative expenses	\$12,260			\$12,260		
Road management investigations	62,060			65,000		
Road building and maintenance investigations	72,298			72,900		
Agricultural engineering—						
Irrigation investigations	83,000	(1)		89,000	(1)	
Drainage investigations	71,500	(1)		83,650	(1)	
Studies of farm structures and their appurtenances	28,000	(1)		28,000	(1)	
Studies of farm mechanical equipment	45,000	(1)		54,000	(1)	
Investigation of mechanical problems related to transportation and storage of perishable food products	7,500	\$7,500		7,500	\$7,500	
Land-clearing investigations	12,000	(1)		12,000	(1)	
Special corn-borer research (development of suitable machinery and equipment for use in controlling corn borer)	50,000	(1)		75,000	(1)	
	443,618	7,500		499,310	7,500	
Bureau of Agricultural Economics:						
General administrative expenses	72,100	48,000	\$500	71,500	48,000	\$500
Farm management and practice—						
Agricultural finance	41,394	(1)		55,164	(1)	
Land economics and land utilization	100,320	(1)		103,126	(1)	
Farm population and rural life	32,825	(1)		33,320	(1)	
Farm management	96,271	60,000	8,000	99,740	60,000	8,000
Cost of production	112,790	80,000		117,650	80,000	
Marketing and distributing farm products—						
Marketing fruits and vegetables	83,980	83,980		86,660	86,660	
Market price trends and transportation	119,250	80,000	1,700	124,370	81,000	3,000
Marketing livestock, meats, and wool	83,140	63,000		83,140	63,000	
Marketing dairy and poultry products	38,222	38,222	12,000	38,522	38,522	13,000
Marketing hay, feed, and seed	52,420	(1)		52,420	(1)	
Cotton handling and marketing	33,150			33,850		
Cotton standards and testing	31,680			32,880		
State cooperation in marketing work	47,198	32,000	500	47,840	32,000	500
Grain investigations	95,860	95,860		96,940	96,940	
Market information	34,720	22,000	200	34,720	22,000	200
Utilization of cotton	35,000			38,100		
Outlook reports	93,220	62,000	1,000	96,491	62,000	1,000
Southwestern irrigated cotton				8,967		
Foreign competition and demand	102,745	70,000	1,000	113,000	71,000	1,000
Cooperative purchasing and marketing	275,000	180,000	20,000	290,000	182,000	6,000
Tobacco stocks and standards	5,000			25,000		
Wool marketing studies	50,000			50,000		
Special corn-borer research (study of adjustments in systems of farming and livestock production and other adjustments made necessary by the corn borer)	15,000	(1)		40,000	(1)	
Total	1,651,285	915,062	44,900	1,773,400	923,122	33,200
Bureau of Home Economics:						
General administrative expenses	18,321	9,160	100	18,500	9,250	
Home economics research—						
Food and nutrition	49,114	49,114	733	62,398	62,398	
Economic studies	37,078			37,078		
Textiles and clothing	27,384			33,384		
Dietary studies	16,140	16,140		16,140	16,140	
Total	148,037	74,414	833	167,500	87,788	
Grand total	17,256,316	9,081,647	423,016	19,170,869	9,961,050	435,386

¹ Indirect relation to food production.



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